Scinta, inc.

Consultants in Radiation Protection (Scientific, Nuclear & Technical Activities) (301) 593-9478

November 18, 1994

FINAL PROGRESS REPORT-DOCUMENT SEARCH
OF DEPARTMENT OF ENERGY DOCUMENTS
WASHINGTON, DC AREA
FOR ROCKY FLATS

Documents generated by the Atomic Energy Commission and it follow-on organizations (ERDA and DOE) relevant to the ROCKY FLATS are stored at several locations in the Washington DC area. These are: at DOE Headquarters in Germantown; at H street; and, at Suitland, MD. These documents have been generated by various AEC/ERDA/DOE Divisions and Offices and are under the control of the Records Holding Area and the History Division. Records have been transferred from the various Divisions and Offices to the Records Holding Area for storage and eventual destruction. Prior to destruction of any document, the document is transferred to the History Division, which may decide to keep it under its control.

Documents retained by the History Division are tracked under the files of individual Secretariat groupings. Secretariat document groups for the years 1948-1957 have been transferred to the National Archives, and are no longer under DOE control. This means that separate access to these documents will have to be obtained from the National Archives. (My present access is limited to DOE, but I have begun the process of gaining access to the National Archive documents. If there are no bureaucratic impediments I should complete this small number of documents by the end of this calendar year.) DOE's History Division still retains control over documents for the years 1958-1974. The Records Storage Center controls more recent documents.

I have carefully reviewed the following listing of documents:

1.The Historian Document Inventory Joblist - 559 pages dated Mar. 08, 1994.

2.Biology and Medicine 1947-1974 List - 23 pages, not dated.

3.The "GTN" (Records Holding Area Active Accessions List for DOE Germantown) - 128 pages dated 4/08/94.

4.The "H" Street (Record Holding Area Active Assessions List) - 95 pages dated 03/30/94.

5.The National Archives and Records Administration Accession Number Master List (01) Washington National Records Center, Pages 2057 through 2061 and pages 3313 through 3359 - 49 pages dated 12/27/93.

6.A list provided to me by the History Division re Rocky Flats Documents.

2421 Homestead Drive, Silver Spring, MD 20902

The result of my review is given in table 1, entitled "DOE Rocky Flats Documents in the Washington DC Area and in table 2, entitled "Secretariat Files at The History Division, DOE Washington, DC." I have completed review of these documents. Please note that some duplicates in the listing occur.

Table 3 contains a listing of documents at the National Archives. These are in process of review.

Data sheets have been filled out on each box and/or document inspected. I have sent the unclassified data sheets and any unclassified documents that I have copied to Sue Rope.
There are many data sheets undergoing declassification, and I will forward them to her as soon as possible.

Bernard Shleien

Bernard Shleien, Pharm.D. FAPHA
Certified Health Physicist

TABLE 1
DOE ROCKY FLATS DOCUMENTS IN THE WASHINGTON, D.C. AREA

JOB	BOX/FILE	LOC	DESCRIPTION	DATE	CL
0006	7775	HIST.DIV	RF AEC SECRETARIAT FILES COLLECTION 6 FLBL 9 2 FOLD	1968-1970	NOT LISTED
0006	7775-013	G-055	RF WEAPONS PRODUCTION PLANTS	06/65-08/65	S
0006	7775-014	G-055	RF WEAPONS PRODUCTION PLANTS	06/65-06/70	S
0006	7837	HIST.DIV.	RF AEC SECRETARIAT FILES COLLECTION 6 FLBL 7 2 FOLD	1970-1972	NOT NOTED
0006	7837-010 THRU 011	G-055	RF FLBL-7-ROCKFLATS (RF) WEAPONS PRODUCTION PLANTS	01/72-01/72	MIXED
0008	7949	HIST.DIV.	RF AEC SECRETARIAT FILES COLLECTION 8 FLBL 7,9 3 FOLD	1972-1974	NOT NOTED
0008	7949-006	HD	RF FLBL 7 ROCK FLATS WEAPON PRODUCTION PLANTS	01/74-06/74	O
0008	7949-010 THRU 7949-011	HD	RF FLBAL 9 ROCK FLATS	02/73-02/73	MIXED
0009	7989	HIST.DIV.	RF AEC SECRETARIAT FILES COLLECTION 9 FLBL 7	1974-1975	NOT NOTED
0009	7989-005	HD	RF FLBAL 7 WEAPONS LABORATORIES	01/74-01/75	O
0030	47	HIST.DIV.	RF OFF.FILES OF JAMES T.RAMEY ROCKY FLATS	NOT NOTED	NOT NOTED
0030	8046-013	SUITLAND	RF OFF.FILES JT RAMEY WEAPON PRODUCTION PLANTS	08/62-06/73	C
0030	8070-008	SUITLAND	RF OFF.FILES JT RAMEY WEAPONS PRODUCTION PLANTS	01/61-12/64	C
0038	19	HIST.DIV.	RF OFF.FILES OF JAMES R. SCHLESINGER RF/3 FIRE/2 FOLD	NOT NOTED	NOT NOTED
0038	33	HIST.DIV.	RF OFF.FILES OF JAMES R.SCHLESINGER RF PLANT	NOT NOTED	NOT NOTED
0038	45	HIST.DIV.	RF OFF.FILES OF DIXY LEE RAY ROCKY FLATS	NOT NOTED	NOT NOTED
1102	2389-024	SUITLAND	RF ROCKY FLATS AREA OFFICE	01/56-01/56	S
1135	5574	HIST.DIV.	RF WASTE DISPOSAL	NOT NOTED	NOT NOTED
1135	5648	HIST.DIV.	RF 13 FOLDERS ON RF AND 1969 FIRE(TITLES NOT LISTED)	NOT NOTED	NOT NOTED
1135	5648-006 THRU 018	V2	RF 019,013 FIRE OTHER VARIOUS SUB. INC.RAD.EXP.PROB.	12/67-11/71	MIXED
1140	60	HIST.DIV.	RF OFF.FILES OF CLARENCE LARSON GRIFFIN TRIP TO RF	NOT NOTED	NOT NOTED
1342	4 AND 8	HIST.DIV.	RF PERIODIC PROGRESS REPORTS ALBUQUERQUE MONTHLY RPTS	1958-59/60	NOT NOTED
1179	3864	MIL.APPL.	RF FLBL 3 ROCKY FLATS	NOT NOTED	NOT NOTED
1179	3864-011	HD	RF FLBAL VOL 3 WEAPON PRODUCTION PLANTS	07/71-12/71	O
1189	0001-001 THRU 0002-020	HD	RF FULL RANGE OF SUBJECT MATTER	03/70-08/81	U
1189	ENTIRE COLLECTION	MIL.APPL.	RF 2 CUBIC FT. INDIVIDUAL TITLES NOT LISTED	NOT NOTED	U
1304	3443-007 THRU 3443-010	V2	RF INVEST FIRE	08/69-08/69	S
1304	3443-011	V2	RF PLUTONIUM MEMO ROCKY FLATS	01/68-01/68	S
1304	5443	DIV.PROD.	RF INVESTIGATION FILE-RF PLANT (4 FOLDERS)	NOT NOTED	NOT NOTED
1304	5443	DIV.PROD.	RF PLUTONIUM--RF MEMO	NOT NOTED	NOT NOTED
1307	5414-036	SUITLAND	RF COMMISSIONER'S CORRESPONDENCE DENVER AREA OFF	03/61-06/61	U
1320	0006-007	G-055	RF PU/U PROBLEMS ENVIRONMENTAL STUDIES	11/63-10/71	S
1320	0014-027	G-055	RF PLUTONIUM FABRICATION MEETING RADIATION EFFECTS	12/67-12/67	O
1330	6	HIST.DIV.	RF OFF.FILES OF THOMAS MCCRAW PU/U PROB.ENV.STUDIES	NOT NOTED	NOT NOTED
1342	4 AND 8	HIST.DIV.	RF PERIODIC PROGRESS REPORTS ALBUQUERQUE MONTHLY	1958-59/60	NOT NOTED
1368	1	HIST.DIV.	RF OFF.FILES OF L.JOE DEAL RF FIRE	NOT NOTED	NOT NOTED
1385	2	MIL.APPL.	RF WHAS 3-3 RF FLBL 2 RF	NOT NOTED	NOT NOTED
1385	4	MIL.APPL.	RF FLBL 4 RF 3 FOLDERS	NOT NOTED	NOT NOTED
6540	145	HIST.DIV.	RF OFF.FILES OF GLEN T.SEABORG 4 FOLDERS	NOT NOTED	NOT NOTED
6540	8494-003 THRU 8494-006	SUITLAND	RF ROCKY FLATS FACILITY	05/69-09/70	MIXED

TABLE 2

ROCKY FLATS SECRETARIAT FILES

Listing of Folders Entitled "Rocky Flats"

In Records Collections in Custody of History Division,

Executive Secretariat, Department of Energy

November 1993

The folders are listed under the records collection of which they are a part. Access to these materials may be arranged by calling 301-9023-5431 or writing the History Division, HR-76, Room F-031. Germantown Building, Department of Energy, Washington, D.C. 20585. Some of thee4 materials are classified.

THIS IS NOT A COMPLETE LISTING OF EVERYTHING IN HISTORY DIVISION CUSTODY PERTINENT TO THE ROCKY FLATS FACILITY

All collections listed below are U.S. Atomic Energy Commission (AEC) records collections.

1968-1970 AEC Secretariat Files--Collection 6
Box 7775 Plants, Labs, Buildings, and Land (PLBL) 9 Rocky Flats (2 folders)

1970-1972 AEC Secretariat Files--Collection 6
Box 7837 PLBL 7 Rocky Flats (2 folders)

1972-1974 AEC Secretariat Files--Collection 8
Box 7949 PLBL 7 Rocky Flats
PLBL 9 Rocky Flats (2 folders)

1974-1975 AEC Secretariat Files--Collection 9
Box 7989 PLBL 7 Rocky Flats

Office Files of Former AEC Chairman Glenn T. Seaborg—Collection 6540
Box 145 Rocky Flats Facility (4 folders)

Office Files of Former AEC Chairman James R. Schlesinger—Collection 38
Box 19 Rocky Flats (3 folders)
Rocky Flats Fire Investigation Report (2 folders)
Box 33 Rocky Flats Plant

Office Files of Former AEC Chairman Dixy Lee Ray—Collection 38
Box 45 Rocky Flats Facility

Office Files of Former AEC Commissioner James T. Ramey—Collection 30
Box 47 Rocky Flats

Office Files of Former AEC Commissioner Clarence Larson—Collection 1140
Box 60 Griffin Trip to Rocky Flats

Files of the AEC General Manager's Office—Collection 1135
Box 5574 Waste Disposal—Rocky Flats
Box 5648 13 folders on Rocky Flats and the 1969 fire (Individual folder titles not listed).

Files of the Division of Military Application

Collection 1189—the entire collection—2 cubic feet of unclassified material (Individual folder titles not listed)

Collection 1179
Box 3864 PLBL 2 Rocky Flats

Collection 1385
Box 2 Medicine Health and Safety 3-3 Rocky Flats
PLBL 2 Rocky Flats
Box 4 PLBL 4 Rocky Flats (3 folders)

Files of the Division of Production—Collection 1304
Box 5443 Investigation of Fire—Rocky Flats Plant (4 folders)
Plutonium—Rocky Flats Memo

Office Files of Thomas McCraw--Collection 1320
Box 6 Rocky Flats Plutonium/Uranium Problems—Environmental Studies

Office Files of L. Joe Deal--Collection 1368
Box 1 Rocky Flats Fire

Periodic Progress Reports—Collection 1342
Box 4 Albuquerque Monthly Reports 1958-1959
Box 8 Albuquerque Monthly Reports 1960

TABLE 3

ROCKY FLATS DOCUMENTS AT THE NATIONAL ARCHIVES

JOB	BOX/FILE	LOC	DESCRIPTION	DATE	CL
4327	1281-001	NA	RF PLB&L2 ROCKY FLATS WEAPON PRODUCTION PLANTS	7/51-12/55	O
4327	1282-020	NA	RF PLB&L 4 RF CONSTRUCTION PLANTS/LABS	6/52-06/52	U
4327	1282-020	NA	RF PLB&L 4 WEAPON PRODUCTION PLANTS	9/55-10/55	U

MJP 42

Risk Assessment, Inc.

5 January 1995

William A. Kemper
7636 West 26th Place
Denver, Colorado 80216

Dear Bill:

This letter provides information in response to your question about a criticality at the Rocky Flats plant at the meeting of the Health Advisory Panel last month. I have made some calculations regarding the consequences of such an event that I hope that it will be informative and useful.

There are three types of energy release associated any criticality: formation of fission product fragments, blown apart by the fission of uranium nuclei; prompt releases of neutrons and gamma rays; and subsequent releases of beta, neutrino, and gamma radiations due to decay of the fission products produced. Most (~83%) of the energy released is in the form of kinetic energy of the fission product fragments. These charged fragments interact strongly with matter in the immediate vicinity of the fissioned atom and produce local heating. About 12% of the energy is emitted in the form of neutrons and gamma rays that create the immediate radiation field, which decreases with distance (as $1/r^2$). The remainder of the energy is released when the fission products decay, which occurs at various times after formation depending upon the half-lives of the fission products.

I have made some calculations for a hypothetical criticality at the Rocky Flats Plant to determine the relative magnitudes of these energy releases and the amounts of ^{137}Cs and ^{90}Sr that might be in the environment as a result. I considered an event in which 1.45×10^{19} fissions occurred. This is a nontrivial event, corresponding to a prompt energy release equivalent to the explosion of 200 pounds (91 kg) of TNT. An event of this magnitude could not go undetected within the plant.

Calculations of the prompt radiation field indicate that radiation doses from gamma rays alone would have been more than 100 rads at a distance of 50 feet and considerably higher at closer distances. Depending upon the circumstances imagined, fatalities due to radiation exposure could have resulted (within 30 days) from a criticality of the assumed magnitude. (I have reviewed the Rocky Flats external (gamma plus neutron doses) dosimetry data for the years 1953–1987 and found only one person with an annual external dose in excess of 10 rem.)

P.O. Box 50430, Idaho Falls, ID 83405-0430 Telephone: 208-529-9171
Suite 301, Historic Federal Building, 591 Park Avenue, Idaho Falls, ID 83402

The number of fissions specified above would have produced about 0.02 Ci of ^{137}Cs. If it were all released to the atmosphere at ground level and the plume were confined to a single wind direction sector, the NRC Reg. Guide 1.111 methodology predicts a deposition of 0.8 nCi/m^2 (or 30 Bq/m^2) at a distance of 2 km from the release point. Cumulative global fallout ^{137}Cs deposition at 40°N latitude is estimated (UNSCEAR 1993) to be about 4500 Bq/m^2. Variations of 1% in the average fallout deposition among sites would exceed the largest projected deposition of ^{137}Cs from a criticality in which 1.45×10^{19} fissions occurred. Such variations are to be expected due to differences in precipitation and in contributions from fallout due to specific NTS shots. The cumulative ^{137}Cs deposition in the Denver area from the NTS was about 400 Bq/m^2.

The relative amounts of ^{90}Sr produced by a criticality and in the soil from fallout are both about 60% of the corresponding values for ^{137}Cs. That is, the deposition at 2 km would be expected to be about 18 Bq/m^2, compared with about 2700 Bq/m^2 from global fallout and about 240 Bq/m^2 from NTS fallout.

My conclusion from these calculations is that any criticality that could have measurably affected the environmental levels of long-lived fission products would have been readily detected by plant personnel because of the magnitudes of the simultaneous initial energy release and prompt radiation field. Although we have not seen any evidence of such an event, we continue to be alert for citations of unusual events, incidents, and accidents at the facility in years past.

Yours sincerely,

Paul

Paul G. Voillequé

cc: John Till, Helen Grogan, Normie Morin

MJP 42

Risk Assessment, Inc.

26 January 1995

Dr. William A. Kemper
7636 West 26th Place
Denver, Colorado 80216

Dear Bill:

I apologize for the fact that my answer to your question about a potential criticality was confusing. I hope that the following will clarify my meaning and address your follow-up questions.

1. My statement was: "Calculations of the prompt radiation field indicate that radiation doses from gamma rays alone would have been more than 100 rads at a distance of 50 feet and considerably higher at closer distances. Depending upon the circumstances imagined, fatalities due to radiation exposure could have resulted (within 30 days) from a criticality of the assumed magnitude."

I did not intend to imply that 100 rad was a lethal dose. My point was that, under certain conditions, fatalities could have resulted. The first question would be the position of an individual with respect to the location of a criticality, which could have been closer than 50 feet. The gamma dose would exceed 400 rad at 10 feet. The second factor, which I should have mentioned, is the neutron dose contribution. It depends on a number of factors that I did not want to guess at.

My recollection was that an acute 350-rad dose would be lethal to 50% of the exposed within 30 days. I have since checked a couple of sources. Radiation Biology (Casarett, Prentice Hall, 1968) gives a range of 250–450 rad for 50% lethality in 30 days. The AEC handbook cited below gives a range of 300–500 rad for a single dose that would produce 50% lethality but does not specify the time. A more recent evaluation is that 50–99% of individuals receiving doses between 350 and 550 rads will die within 6 weeks (Conklin and Walker, Military Radiobiology, Academic Press, 1987). These numbers are not directly comparable because the time periods differ, but they provide some perspective.

2. A second point, which I could have given more emphasis, is that an explosion of 200 lb (91 kg) of TNT would do a lot of physical damage in the plant itself. I believe that such damage would be very difficult to keep secret. Many accidents were discussed widely, publicized in AEC safety bulletins, and used as the basis for training to avoid similar occurrences elsewhere. The 1963 report Medical Aspects of Radiation Accidents, a Handbook for Physicians, Health Physicists, and Industrial Hygienists included a chronology of radiation accidents worldwide. There were eight severe criticality accidents listed, six of

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which occurred in this country and I counted seven lesser criticalities in the ~150 other accidents. The compilation, which includes "metallic Pu fire" on 11 September 1957, covers the period from 1945 (criticality at Los Alamos) through the SL–1 accident here in Idaho in January 1961. A copy of the list, enlarged to improve legibility, is attached.

3. In estimating the deposition that would occur near Rocky Flats from a criticality there, I assumed a ground level release. Had I assumed an elevated release between 30 and 100 meters, the calculated depositions for unstable dispersion conditions would have been in the range of 0.3–1 times my stated estimate of 30 Bq/m^2. For elevated releases under stable dispersion conditions the estimated depositions at 2 km would be substantially lower than that value.

Regulatory Guide 1.111 does not discuss assumptions made about particle size. However, they permit the method to be used for both radioiodine and particulate deposition. I believe that using their method would produce a high estimate of the local deposition of particles released from such an event.

4. The Denver area ^{137}Cs deposition of ~400 Bq/m^2 is from only those detonations that occurred at the Nevada Test Site. The larger estimate of 4500 Bq/m^2 given by UNSCEAR reflects all weapons testing and thus includes fallout from tests conducted by the US in the Pacific and by the USSR on its territory.

I believe that your question about whether film badges were worn by persons fighting the fires will be difficult to answer definitively, but I will see what information is available.

I look forward to seeing you in February.

Yours sincerely,

Paul

Paul G. Voillequé

cc: John Till, Helen Grogan, Normie Morin

Environmental Perspectives, Inc.
5800 S. Marbrisa Lane, Idaho Falls, ID 83406 Phone (208) 522-5367 Fax (208) 523-5792

February 28, 1995

Dr. W. Gale Biggs
W. Gale Biggs Associates
P.O. Box 3344
Boulder, Colorado 80307

Dear Dr. Biggs:

It was a pleasure to meet you last week in Denver. I hope to speak with you again about our evaluations of historical environmental data related to the Rocky Flats Dose Reconstruction Project.

This letter is in response to the question you raised about the *mass* of plutonium per volume of air which is equivalent to the radiation protection "standard." First, I'd like to clarify what I am using for a "standard." The DOE's secondary "standard" for plutonium in ambient air is called the "derived concentration guide," or "DCG." The DCG is that concentration that would result in a committed effective dose equivalent of 100 mrem from 1 year's chronic exposure or intake. In calculating the DCGs for air inhalation, the exposed individual is assumed to inhale 8400 cubic meters of air during the year.

The derived concentration guide which Rocky Flats currently uses for Pu-239 in air in unrestricted areas is 2×10^{-14} µCi/mL of air (DOE Order 5400.5, *Radiation Protection of the Public and the Environment*). This concentration guide is based on the most conservative chemical form (i.e. that form which would produce the highest dose). For oxides of plutonium, the more likely form in the environment, the derived concentration guide is two times higher, or 4×10^{-14} µCi/mL of air.

Based on a half-life of 24,065 years, one gram of Pu-239 is equivalent to 2.3×10^{-3} TBq (Shleien B. *The Health Physics and Radiological Health Handbook*, 1992, page 265), or 0.062 Ci. So, for a DCG of 2×10^{-14} µCi/mL, the equivalent mass per unit volume is:

$$DCG_{mass} = (2\times10^{-14}\ \mu\text{Ci Pu-239/mL air})\ (10^{6}\ \text{mL air/m}^{3}\ \text{air})(1\ \mu\text{g Pu-239}/0.062\ \mu\text{Ci Pu-239})$$

$$\mathbf{DCG_{mass} = 3 \times 10^{-7}\ \mu g\ Pu\text{-}239\ per\ cubic\ meter\ air}$$

(equivalent to 100 mrem per year)

As I mentioned when we spoke, air from non-urban locations in the U.S. averages around 40 µg dust per cubic meter air.

I should make it clear that although the DCGs are derived from the DOE public dose limit of 100 mrem per year from *all* exposure pathways, the Environmental Protection Agency further limits the routine *airborne* emissions from DOE facilities such that members of the public do not receive an effective dose equivalent greater than 10 mrem per year. The mass concentration based on this EPA standard (Title 40 CFR Part 61, Subpart H) would thus be 10 times less than I have computed above.

These results are in agreement with those sent to you last year from P.G. Voillequé of our research team (copy of memo attached). He had computed that a mass concentration of about 1×10^{-7} μg of Rocky Flats plutonium (mixture of isotopes; not just Pu-239) per cubic meter was equivalent to a committed effective dose equivalent of 25 mrem per year.

I hope this satisfies your curiosity on this issue. We appreciate your taking the time to give us your viewpoints on the Rocky Flats Dose Reconstruction Project.

Sincerely,

Susan K Rope

Susan K. Rope
President, Environmental Perspectives, Inc.
Consultant to ***Radiological Assessments Corporation***, Phase II Rocky Flats Dose Reconstruction Project

Attachment: PGV memo dated 4/15/94

copy to: Norma C. Morin, CDHE
Paula Elofson-Gardine, EIN
RAC Team, via CAPs

MJP Risk Assessment, Inc.

42

7 April 1995

Gregory K. Marsh
Suite 12
7700 West 61st Avenue
Arvada, Colorado 80004

Dear Greg:

This letter is in response to your question during my presentation at the HAP meeting about the filters that were used for early in-plant and effluent air sampling at Rocky Flats. The filter's designation is HV–70; the letters signify Hollingsworth and Vose, the manufacturer. The HV–70 is a mixed fiber filter composed of cellulose and asbestos; fiber diameters range from 0.1 to 35 µm. In contrast to membrane filters, fiber filters are not characterized by a pore size. At Rocky Flats, the HV–70 filters were used from 1953–1973, which includes the time when the largest routine effluent releases of plutonium occurred.

Measurements of filter efficiency at various face velocities, performed by Lockhart and coworkers, are shown in the following table. Some of these values are also cited in the ANSI Standard N13.1 and in the ACGIH air sampling handbook. For effluent monitoring at Rocky Flats, a nominal flow rate of 2 ft^3 min^{-1} was used with a filter diameter of 2¼ inches. If an annulus ⅛ -inch wide was covered by the holder, the operating face velocity would be ~53 cm s^{-1}. The table shows that at this face velocity the HV–70 collection efficiency for 0.3-µm particles would be expected to be about 99%.

Retention of DOP (0.3-µm) Particles by HV-70 Filters[a]

Face velocity (cm s^{-1})	Retention (%) of DOP aerosol
7.2	96.0
10.7	96.6
14.2	97.1
17.6	97.5
26.7	98.2
35.3	98.8
53	99.2
71	99.6
106	99.8
141	99.92
211	99.95
283	99.98

[a] L. B. Lockhart et al., Characteristics of Air Filter Media Used for Monitoring Airborne Radioactivity, Naval Research Laboratory, NRL Report 6054 (March 1964).

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The ~1 g cm^{-3} DOP test aerosol has an aerodynamic diameter (~0.3 µm) that is close to those of particles exhibiting the greatest penetration through efficient filtration media. Aerodynamic diameters of plutonium aerosols that have been observed in Rocky Flats facilities are comparable to that of the DOP test aerosol.

Some additional measurements were made by Lockhart et al. of HV–70 collection efficiencies using ambient aerosols. Results of their measurements at a face velocity of 55 cm s^{-1} should be close to those expected for HV–70 filters as used at Rocky Flats. Radon daughters were collected by HV–70 filters with an efficiency of 98.4–98.7 percent. Radon daughters were found to be associated primarily (80–90%) with particle sizes less than 0.3 µm. Two measurements of the collection efficiency of HV–70 filters for fallout radionuclides yielded values of 99.3±0.3 and 100.9±0.9 percent. These data were obtained for face velocities of 55 and 53 cm s^{-1}, respectively. Fallout fission product particle size distributions contained particles with diameters primarily (>90%) greater than 0.3 µm.

I believe that you also inquired about the current permissible level of plutonium in air. Doses to the public due to airborne effluents from DOE facilities are limited to 10 mrem y^{-1} by the EPA (40 CFR 61, Subpart H). For plutonium releases from Rocky Flats, inhalation is the primary exposure pathway. Using the dose conversion factors tabulated in ICRP Publication 56, I have estimated that $^{239/240}$Pu present in offsite air at an average concentration of 4.0 fCi m^{-3} (4.0 x 10^{-15} Ci m^{-3}) would produce a committed effective dose equal to that limit. This nominal estimate is for persons above age 15. Younger persons exposed to the same aerosol would receive smaller doses from inhalation. For the isotopic mixture of Rocky Flats plutonium (which has a specific activity of 0.072 Ci g^{-1}), this corresponds to a mass concentration of about 56 fg m^{-3}, ~5.6 x 10^{-8} µg m^{-3}. Although the result depends somewhat upon particle size and physical activity of the exposed person, I believe that this generic estimate provides the basic information that you sought. Typical ambient levels of airborne dust are measured in tens of µg m^{-3}. Measurement of $^{239/240}$Pu concentrations at this level requires sampling of large air volumes, chemical separation of the $^{239/240}$Pu from the dust, and counting by alpha spectrometry.

If you have additional questions about these topics, please don't hesitate to get in touch with me. We appreciate your interest in the dose reconstruction project.

Yours sincerely,

Paul

Paul G. Voillequé

cc: Phoebe Boelter, Helen Gregan, Normie Morin, John Till

McGavran Toxicology Consulting, Inc.

841 Harcourt Road • Boise, Idaho 83702
Phone: 208 336-5617 • Fax: 208 336-0045

April 17, 1995

To: Owen Hoffman
Jim LaVelle
Normie Morin

From: Pat McGavran, Consultant to ***RAC***, Phase II, Rocky Flats Dose Reconstruction Project

Regarding: **The question of historical carbon tetrachloride use in the Denver area.**

At the September 1994 evening public meeting, hosted by HAP panel members Dr. Hoffman and Dr. LaVelle, a member of the public recommended that the release of carbon tetrachloride from RFP activities be put into perspective with an estimate of Denver area carbon tetrachloride use and release, since this chemical was so widely used in the dry cleaning industry and other industries in the 1950s. The panel members responded that it would be an interesting comparison.

I attempted to look into the number of dry cleaners in the Denver area in the 1950s and 1960s and how much carbon tetrachloride each one might use. I contacted several dry cleaner associations and dry cleaners who had establishments in the 1950s. They believe that carbon tetrachloride was <u>not</u> used extensively as a dry cleaning solvent. It was used as a spot remover by many establishments, but estimates of maximum use were one to five gallons per year for each establishment. Carbon tetrachloride is used as a degreasing and metal cleaning agent, in the manufacture of paints, plastics, chlorofluorocarbon refrigerants, foam-blowing agents and solvents, and as a grain fumigant. The major sources of carbon tetrachloride released in an urban environment appear to be from its use in the manufacture of these other products, and not from the dry cleaning industry.

The EPA Toxic Release Inventory shows no facilities in the Denver areas reporting carbon tetrachloride emissions in 1993. I searched the 1987-1992 release inventory and found 5 facilities in the Denver area reporting carbon tetrachloride release estimates for a total maximum air release of about 1,200 lbs (545 kg). Ideally, we would like to obtain release estimates for the 1950-1970 time period to compare to the RFP emissions, but unfortunately such estimates are not available.

Thank You.

RAC
Radiological Assessments Corporation
"Setting the standard in environmental health"

April 18, 1995

Ms. Paula Elofson-Gardine
Environmental Information Network, Inc.
P.O. Box 280087
Lakewood, CO 80228

Dear Paula and Susan,

This letter has two purposes. First, to thank you for your time last month and the opportunity to discuss issues with you. I understand how valuable your time is, and appreciate you giving so much of it on a Saturday to meet with me. As far as I am concerned, the time together was extremely helpful. As promised, I plan to share much of what we discussed with others involved in the study.

The other purpose of this letter is to respond to several issues you raised about the letter you received from the Health Advisory Panel dated February 7, 1995. This letter was responding to the letter that you had faxed to MGA/Thompson on January 10, 1995, concerning the Outreach Presentation Outline for Historical Public Exposures Studies on Rocky Flats. In the letter from the Health Advisory Panel, a number of questions that you had raised were not answered directly, because it was indicated that *RAC* would address these. We would like to take the opportunity to do so now.

As we discussed at our meeting last month, we are always open to ideas about how to improve our analyses or another approach to take. For example, I mentioned the difficulties we were having with the mass balance approach to analyzing the 57 fire and the 69 fires. We need your help on this and do not rule out this approach if new information can be provided. Also, for the mass balance approach, we would like Bill Kemper to peer review our calculations and give us his ideas. My point is, our responses below document our understanding of the issue up to now, and we are always open to suggestions you may have about other approaches that may be taken. What we need at this stage are your suggestions about how look at these issues differently.

For clarity we have provided the number that CDPHE assigned to the question as well as the text of the question you posed.

23. Re: Slide 12 - 8,000 materials screened w/12 materials listed.

<u>Workers and citizens have expressed concerns that materials they considered to be of significant quantity were glossed over such as: Dioxin (many incineration practices with greater than 80% pvc/plastics feedstock). PCB's (incinerated, dripping off of the roofs, possibly dumped into water drainages!). Asbestos (1940's construction, asbestos abatement and other problems all over RFP). Methyl ethyl ketone (used in large quantities, possible dumping near or in waterways, air emissions probable (volatilization), Acetone, etc</u>.

As you know, Tasks 1 and 2 of Phase I of the project identified 8000 materials that were used or stored at the RFP. Through a series of evaluations the number of materials of concern for more detailed study was narrowed down to 7 chemicals and 5 radionuclides. The evaluations were based on the quantity used, the toxicity and carcinogenicity, and the potential for environmental release and transport offsite.

Task I of Phase II involved an in-depth review of all data and information developed during Phase I. *RAC* has evaluated, and will continue to assess the completeness of the list of chemicals and radionuclides of concern. It is not our intent to gloss over any concerns about chemicals.

As you are aware dioxin release from combustion sources at the plant is currently being evaluated and an updated assessment will be presented at the HAP meeting in May. We have determined that, of the eight incinerators onsite, there is one incinerator, the multiple chamber retort in building 771, of possible concern for offsite releases. Also of concern is an open pit burning operation from which dioxin release may be impossible to quantify.

Although asbestos abatement activities and deteriorating asbestos building materials and waste may present an onsite hazard to workers, asbestos transport offsite appears not to be a significant problem. Could you further describe asbestos problems you believe may have resulted in offsite exposures?

The use and inventory amounts of methyl ethyl ketone were addressed in a letter to EIN dated August 14, 1994 and in a presentation to the HAP in September of 1994. After carefully reviewing ChemRisk's analysis, *RAC* concluded that methyl ethyl ketone was not a chemical of concern for the dose reconstruction project and should not be evaluated further.

PCBs or arochlors were briefly discussed by ChemRisk in their Task 2 report. An inventory quantity of 0.122 kg was reported in the 1988/89 inventory but it was recognized that larger amounts were likely used in electrical transformers, capacitors, hydraulic presses and pumps onsite. ChemRisk suggested that any environmental release of PCBs from equipment would more likely be related to accidents and spills than to routine plant operations. For this reason, PCBs were not included in the chemicals of concern list but were recommended to be evaluated if found to be associated with accidents or incidents. ChemRisk also suggested that soil sampling data might be the best way to evaluate the hazards associated with PCBs. ChemRisk reviewed the historical work of Buffer (1990), which described handling of PCBs at the site. This included 'temporary' storage of 17 barrels of PCB oil located on a Lafayette farm in 1980, a shipment of these 17 barrels and perhaps more, from the RFP to Texas for disposal in 1982 and the burning of 1 gallon of PCBs in the fluidized incinerator in 1982. The burn was monitored and a report to CDH and the EPA judged the burn as successful, accomplishing greater than 99% destruction of the PCBs. These actions did not appear to involve any spills or large releases to the environment.

We agree that PCBs were not routinely released offsite and that the offsite hazards of PCBs would be associated primarily with accidental leaks and spills from equipment. Sections 5 and 6 of ChemRisk's Task 3 and 4 Report discussed the handling of PCB wastes at RFP, and accidents and incidents involving PCBs. This discussion included a description of PCB movement through the storm drainage system and pipes from the leaking transformer on the roof of B-707. The report also describes a soil sampling program, initiated in 1991 to examine 34 sites for potential contamination. We agree with the assessment that none of the waste events reported were associated with releases of PCBs to the offsite environment and that the leaking transformers did not result in a significant offsite release. We plan to thoroughly evaluate any available soil sampling data.

RAC was not previously aware of a concern about acetone. Inventory amounts reported are 444 kg in 1988 and 1562 kg in 1974. The EPA classifies acetone as a noncarcinogen. Acetone can be contaminated with small amounts of benzene, which is a carcinogen, but acetone itself is not considered to be carcinogenic or teratogenic. ChemRisk calculated an allowable quantity for acetone of 560,000 kg and an actual quantity of 22,349 kg, suggesting the actual quantity was 25 times less than the quantity of concern. The threshold limit value for acetone, recommended by the American Conference of Governmental Industrial Hygienists to protect workers is 750 ppm or 1780 mg/m^3. Acetone is volatile and will readily evaporate into the air. It is biodegraded and does not bioconcentrate in fish or wildlife. Based on this information, we would hesitate to recommend further investigation of historical acetone release. If you have additional information about quantities and uses of acetone at the RFP that do not support this conclusion, please let us know.

32. Re: Slide 16 - Graphic showing just air pathway. Text: Main pathway of Exposure is inhalation

- need to fill in missing data

...<u>A mass balance and throughput analysis needs to be done for each process (which is possible through the analysis of "Traceability" records, operator logs, and shift reports), for the entire "life of the process" to determine missing and unaccounted for materials</u>.

The idea of using plutonium accountability data to assess the magnitudes of plant releases was initially attractive. Although *RAC*'s experience with uranium accountability data at the Fernald site in Ohio had shown that there were large uncertainties in those data, it was thought that plutonium accountability data would prove to be more reliable. We previously requested the declassification of information regarding the 1957 and 1969 fires and will further evaluate the data that have been released. However, it does not now appear that these data will be particularly helpful in estimating the releases from these events.

Examination of the data on disposal of wastes from Rocky Flats and on accountability for particular events has shown that there are large uncertainties in those data. For many years, the estimates of the amount of plutonium in solid wastes were necessarily very crude. Obtaining a representative sample of the plutonium in a waste container was, and still is, a very difficult task. Systems were developed later to count neutron emissions from the waste package. However, these drum counters were not employed before 1964. Routine use of reliable instruments did not begin until even later.

Poor estimates of the amounts of plutonium wastes shipped to Idaho were one source of the large (~1000 kg) cumulative inventory difference at Rocky Flats by 1967. This difference is shown in the inventory data declassified by Secretary O'Leary last June. Another source was hold-up of plutonium in equipment. This was illustrated in the mass balance for the 1969 fire. The extensive cleanup after the fire led to the recovery of about 100 kg <u>more</u> plutonium than was in the book inventory for the buildings prior to the accident.

Our conclusion is that mass balance data cannot by themselves be used to estimate releases from the Rocky Flats Plant. The fact that about 6 kg of plutonium were unaccounted for following the 1957 fire does not mean that amount was released during the event. Similarly, the post-1969 fire accounting, which found much more plutonium than was thought to be present, does not mean that there were no releases from that fire.

We welcome any suggestions that you may offer as to how to proceed further with this issue. We also hope that Bill Kemper will review or work on this matter and offer his ideas. Also, if there are data that we are overlooking, we welcome them as well.

33. Re: Slide 16 - Graphic showing just air pathway. Text: Main pathway of Exposure is inhalation

- need to find more information, i.e. classified information

* <u>It should be noted that a whole class of documents will not show up on listings of classified documents because of disposition to a special DOE "black hole" reserve that is difficult to access (Q clearance does not guarantee access). Data gaps and document problems need to be augmented by Whistleblower, insider, and retiree interviews</u>.*

We first discussed with you the possibility of the existence of one or more inaccessible document repositories within the DOE or contractor system during the evening meeting on February 21, 1995 at the Casa del Sol restaurant. We will pursue the leads you provided to Bob Meyer in phone conversations during the week of March 27, 1995, and will report to all interested parties if additional material is found during this search. We have talked with key Union representatives onsite, requesting access to information concerning environmental releases from RFP, but will contact these individuals again with more specific questions. We will also ask a number of other individuals within the DOE and contractor system whether they are aware of "in transit" or other categories of relevant documents which might not otherwise be revealed during our document searches. In this context, it would be helpful if you could provide *RAC* with the titles of any documents which might be contained in such hidden repositories, or topics or events to which such documents are related.

We agree that it is important to augment our information by talking to additional individuals, including "whistleblowers", knowledgeable about RFP releases. We have been actively pursuing this line of investigation during the study, and urge you to provide us with the names of individuals with information of value to the study. As you are aware, we can provide reasonable assurance that these names will be handled in confidence, within the limits of the Confidentiality

Policy recently established for the project. As we recently discussed, perhaps the best way to provide such names would be directly to me, to ensure that the minimum necessary number of individuals are involved in any such confidential process. We are anxious to talk with individuals holding information of potential value to the dose reconstruction, and urge you to carefully consider release of such individuals' names, with their permission.

39. Re: Phase II Overview.

<u>*How can verification be conducted, if monitoring data and environmental sampling is problematic (which it is.)? Routine and non-routine emissions need to be modeled on a mass balance basis coupled with meteorological "best guesses" for deposition.*</u>

Our research efforts include investigation of the effluent and environmental monitoring data and evaluation of biases and uncertainties of the sampling and measurement techniques employed. These evaluations may lead to revised estimates of releases or environmental concentrations. In any case, the uncertainties in the measurements will be reflected in the calculations of exposures, doses, and risks that are based upon those measurements. We are also collecting environmental data from monitoring programs independent of the Rocky Flats facility, and will use them in the assessment.

As we have explained previously, assessment of the health risks from Rocky Flats is a puzzle. Some of the pieces are missing, some are blurred; colors have faded. We are looking for missing pieces and clues about the meanings and limitations of pieces that we have. The goal of our work is to assess the available information and use it to assemble a coherent picture. The picture will not be perfect, but the imperfections will be reflected in the uncertainty bounds of the risk estimates.

For reasons described above, a mass balance approach does not appear to be a viable method for evaluating routine or accidental releases. The largest uncertainties in the mass balance estimates are due to difficulties in measuring solid wastes that were sent offsite for burial. Reliable data on solid waste shipments were not obtained routinely until after the most important events causing offsite exposure had already occurred and additional filtration had been added to reduce routine effluents.

Again, we welcome ideas about how to proceed with the analysis of the mass balance approach and the possible assistance of Bill Kemper in reviewing our research. We will try to explain carefully the difficulties associated with this method.

If you have any questions or suggestions relating to any of these responses please do not hesitate to contact us. As always, we very much appreciate your interest in the work and look forward to your continuing participation.

Sincerely,

John E. Till, Ph.D.
President

enc: Letter to EIN from *RAC* dated August 13, 1994
copy to: CDPHE
RAC Team

McGavran Toxicology Consulting, Inc.

841 Harcourt Road • Boise, Idaho 83702
Phone: 208 336-5617 • Fax: 208 336-0045

April 27, 1995

To: Dr. Jim LaVelle, Health Advisory Panel
Dr. Normie Morin, Colorado Department of Health

From: Dr. Pat McGavran, Consultant to *RAC*, Phase II, Rocky Flats Dose Reconstruction Project

Re: **Response to the question about the increased sensitivity of alcoholics to carbon tetrachloride.**

People who drink alcohol are more susceptible to the toxic effects of chlorinated solvents.

Carbon tetrachloride (CCl_4) is a liver toxin causing impaired secretion of triglycerides with resultant fat accumulation and other effects that can progress to scarring of the liver. CCl_4 also causes kidney injury and neurological effects including central nervous system depression. The mechanism of toxicity is believed to involve metabolism of CCl_4 by the P-450 enzymes to a highly reactive trichloromethyl radical which damages liver tissue.

Although there is inadequate evidence that inhalation of CCl_4 causes liver cancer in humans, it has caused an increase in liver tumors in experimental animals in a number of studies. According to Casarett and Doull, ethanol appears to be a cocarcinogen for liver cancer.

Alcohols and ketones can exert a potentiating effect on the acute inhalation toxicity of CCl_4. Ethanol has been repeatedly associated with increased liver and kidney injury in humans exposed to CCl_4. Most serious and fatal cases of CCl_4 poisoning have involved alcoholics or people who had several alcoholic drinks before or during their exposure. In one case, CCl_4 exposure caused death in an alcoholic with an estimated exposure of 250 ppm for 15 minutes. Nonalcoholic workers exposed to the same level for four hours experienced no significant clinical signs except for a slight headache (Norwood et al., 1950). In 1939, a case was reported of two men cleaning draperies and furniture, both working in the same room for the same amount of time. One was a heavy drinker and died from the exposure. The other man, a nondrinker, experienced nausea and headache but recovered quickly after exposure to fresh air (ATSDR, 1988). New et al. (1962) described 19 cases of acute renal failure due to inhalation of CCl_4, and found that 17 of the 19 patients were drinking alcohol at the time of their exposure. There are numerous other clinical reports suggesting that alcohol greatly enhances the acute toxic effects of CCl_4. Although the exact mechanism for this enhancement is unclear, it has been suggested that these chemicals may increase the metabolic activation of CCl_4 (Plaa 1988). The potentiation of effects resulting from chronic exposure to CCl_4 is not well understood. If the reactive trichloromethyl free radical or the trichloromethyl peroxy free radical plays a role in carcinogenesis then potentiation of cancer, as well as toxic effects, might be expected.

I attempted to search EPA and ATSDR references to risk assessments and health assessments involving CCl_4 to look for a precedent for using alcoholics as the most sensitive population for the endpoints of liver carcinogenesis. So far I have been unable to find an example of this approach.

References

Goldfrank's Toxicologic Emergencies, 4th ed. Appleton and Lange, Norwalk, CT 1990. p. 185.

Plaa, GL 1988. Experimental evaluation of haloalkanes and liver injury. Fundam Applied Toxicol. 10:563-570.

Casarett and Doull's Toxicology, 4th ed. Amdur MO, Doull J, Klaassen CD, eds. Pergamon Press, New York. pp. 192, 345, 693, 700.

MJP 42

Risk Assessment, Inc.

7 May 1995

Ms. Susan Hurst
Environmental Information Network, Inc.
P. O. Box 280087
Lakewood, Colorado 80288

Dear Susan:

In response to your question about the ribbon laser system that had been used at Rocky Flats, I have contacted Gerhard Langer, the scientist who performed many of the resuspension studies in the local environment while on the staff at Rocky Flats. He is still active as a consultant to the current contractor.

He informed me that they used the laser system to study relatively small particles, above ~ 1 µm in diameter, that are resuspended by impacts of much larger particles (>50 µm) that are bounced along the ground when wind speeds are adequate. They also used saltation counters to measure the numbers of these larger particles. They performed some initial studies using the laser system and found that they could begin to see some small particle resuspension at wind speeds of about 35 miles per hour (measured at 10 meters above ground).

The project was stopped because of laser safety concerns. At the time the studies were being performed, a pilot in Los Angeles was accidentally blinded by a laser beam being used on the ground and his plane crashed. Although the power of the laser was relatively small and a beam stop was being used, the proximity of the Jefferson County Airport caused concern about the possibility of a similar incident.

Although the experimental program was short lived, the limited results support the approach that we are taking, namely to look in detail at the high wind speed events that occurred after the contamination of the soil in the 903 Area.

If you have any questions about this information, please don't hesitate to contact me. I again apologize for forgetting to pursue this question sooner.

Yours sincerely,

Paul

Paul G. Voillequé

cc: Phoebe Boelter, Normie Morin

McGavran Toxicology Consulting, Inc.

841 Harcourt Road • Boise, Idaho 83702
Phone: 208 336-5617 • Fax: 208 336-0045

July 25, 1995

To: Health Advisory Panel Dioxin Subcommittee
James LaVelle
Niels Schonbeck
Owen Hoffman
Robert Quillin
Paula Elofson-Gardine
Karen Pitts
Norma Morin

From: Pat McGavran

Re: Acquiring and Analyzing Incinerator Ash Samples for Dioxins

Because of the difficulty and considerable cost, it does not seem feasible to pursue the analysis of samples of ash stored at the RFP.

The dioxin experts invited to the February HAP meeting recommended that the HAP consider analyzing ash samples from the incinerator in Building 771 for dioxins. Because it has more relevance to the amount of dioxins in the exhaust the experts thought that filter ash would be the best to sample, followed by fly ash then bottom ash.

Various forms of the Building 771 incinerator ash are stored at the Rocky Flats Plant. Most of it seems to be bottom ash and no filters, filter ash or fly ash has been identified. The ash contains plutonium.

Terrul Winsor with *RAC* met with Rocky Flats officials, records personnel and others with knowledge of the incinerator. He determined that the Fissile Material Waste Inventory information on the Safeguards Accountability Network does have entries and storage locations for the pulverized incinerator ash, (also called virgin ash), soot (which appears to be material collected while cleaning the firebox), and soot heels (which were chemically treated). Almost all of the ash is stored in a plastic bag placed in a nalgene collected while cleaning the firebox), and soot heels (which were chemically treated). Almost all of the ash is stored in a plastic bag placed in a nalgene bottle, placed in a can, then placed into a packing drum. Ash generated from 1985 to 1988 has the most reliable records associated with it. One of the incinerator operators we talked with thought that any of the samples would be sufficiently representative of the process at any time during the incinerators operation since the process did not undergo major changes.

Attached is a one page memo from Jack Long, who consulted with DOE and EG&G staff and researched the possibility of analyzing the ash at the Rocky Flats Plant, at the request of Terrol Winsor. He found that the Rocky Flats Environmental Technology Site does not have the capability to conduct the analysis required. He also states that current regulations prohibit material that contains significant amounts of plutonium, (which this ash does) to be sent offsite for analysis.

I discussed this problem with chemists at Rocky Flats, Los Alamos, and with Thomas Tiernan, one of the expert speakers whose laboratory at Wright State University conducts dioxin analysis.

The ash must be subject to solvent extraction to remove the dioxin, then the extract can be analyzed using GC-Mass Spec. The extraction procedure is the most difficult and time consuming part of the procedure.

One suggested approach was to extract the ash in a glove box at the Rocky Flats Plant, and if regulations allow, the extract could then be sent offsite to a laboratory that is equipped to do dioxin analysis and handle radioactive material. Although many analytical labs handle material contaminated with short-lived radionuclides, many are reluctant to handle plutonium-contaminated materials. However, there are offsite labs which might do the work if the extract was sufficiently nonradioactive, but the cost would be high because this could be a one-time use for the analytical equipment.

In agreement with the information Jack Long provided, other organic chemists and managers with Materials Characterization and Analytical Chemistry at the Rocky Flats Plant told me that none of the laboratory facilities at Rocky Flats are set up to do the required extraction or analysis. Constructing the capacity to do extraction and analysis for dioxin at Rocky Flats would require funding (perhaps more than $ 150,000 in capital outlay, plus funding for personnel time) and establishment of new laboratory protocols and safety procedures.

Although possible, the extraction and analysis of the plutonium-contaminated ash samples for dioxins is not feasible and would be expensive and difficult to conduct. Because of this, and the fact that the amount of dioxin in bottom ash will not directly correlate to the amount of dioxin which was released, I recommend that the HAP not pursue ash sample analysis.

Thank You.

Post-it® Fax Note 7671 | Date 8-1-95 | # of pages 2
To Pat McGovern | From Jack Long
Co./Dept. | Co. SAIC
Phone # 208-336-5617 | Phone # 303-966-22
Fax # 208-336-6095 | Fax # 303-966-5887

To: Reg Tyler, DOE, Team Lead, Residue Stabilization

From: Jack Long, SAIC and Robert Lucero, DOE

Subject: Dioxin Formation/Distribution in the Building 771 Incineration Operation

It appears that the conditions for the formation of dioxins existed at times during the incineration process. However, dioxins if formed, would be in the PPB range. Assuming that some amount of dioxins were formed, it is likely that most of the material did not stay with the ash formed. The measured temperature in the incinerator (near the front and top of the fire box) was approximately 850 degrees Celsius. The melting point of the dioxin (TCDD) is listed as 295 to 325 degrees Celsius. Thus, the temperature differential was high enough so that most material would be volatilized and carried away with the air stream. In addition, some amount of dioxin in the particulate state would be carried away by the air stream.

A consideration of the process flow for the incinerator shows that after the fire box, there is a heat exchanger with a vertical section followed by a horizontal section (see attached process flow diagram). Fluffy solids were routinely removed from the horizontal section during operation. It is in this material that dioxins might be found. This material from the horizontal section was backlogged as IDC 422, Soot. Any material carried beyond the heat exchanger would be caught in the caustic scrubber or the HEPA filters downstream from the scrubber. The possibility of dioxins in the caustic scrubber solution is undetermined and was not analyzed prior to processing in the Building 374 evaporator. The solution was sent to the process tanks and mixed with product from other processes from the facility. The use of the evaporator to treat the caustic scrubber solution did not isolate this solution from mixing with other waste streams. The material that is left at the end of the evaporator process is collected and readied for cementation into salt crete. Testing of the salt crete for dioxins has been completed and results are below regulatory requirements and detection limits. There is above Economic Discard Limit (EDL) soot in the current backlog, but no below EDL soot. The below EDL material was made into a solid with concrete and shipped off-site. The above EDL material was sent to dissolution process or backlogged. As best we could determine, this material has never been analyzed for dioxins. Rocky Flats does not have the equipment to do the analysis. The material could not be sent to industrial labs off-site under past and current regulations because of the plutonium content.

In summary, any dioxins formed are most probably in the backlogged soot, IDC 422, or reside in a cement matrix off-site. Unless some creative manipulation can be done around the current regulations/conditions analytical data will not be forth coming.

We wish to express our thanks to Keith Grossaint, Paul Williams and Jack Weaver, all of EG&G and Tim Burns, LATO, for providing helpful information.

INCINERATION FLOW DIAGRAM